Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
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Amendment of Part 2 of the Commission's Rules to Allocate Spectrum Below 3GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Systems, including Third Generation Wireless Systems	)	ET Docket No. 00-258
	)	
Petition for Rulemaking of the Cellular Telecommunications Industry Association Concerning Implementation of WRC-2000: Review of Spectrum and Regulatory Requirements for IMT-2000	)	RM-9920
	)	
Amendment of the U.S. Table of Frequency Allocations to Designate the 2500-2520/2670-2690 MHz Frequency Bands for the Mobile-Satellite Service	)	RM-9911

COMMENTS OF QUALCOMM INCORPORATED

QUALCOMM Incorporated hereby submits these comments in response to the Commission's *Notice of Proposed Rulemaking*, ET Docket No. 00-258 (released January 5, 2001) ("NPRM"). QUALCOMM applauds the Commission for its leadership in initiating a process to explore the use of frequency bands below 3 GHz to support the introduction of new advances wireless services, including third generation ("3G") and future generation wireless services. QUALCOMM supports the Commission's spectrum management goals of allowing

licensees freedom in determining the services to be offered and the technologies to be used,[1] encouraging licensees to make the most efficient use of their assigned frequencies in response to market demands,[2] and allocating available spectrum in a manner consistent with the decisions adopted at the International Telecommunication Union's ("ITU") World Radiocommunication Conference 2000 (WRC-2000) to maximize opportunities for global roaming and economies of scale.[3]

QUALCOMM is a leader in developing, delivering, and enabling innovative digital wireless communications products and services based on its digital technologies. QUALCOMM is dedicated to growing the wireless industry through technology licensing, CDMA chipsets and system software, satellite-based systems, and new innovations in wireless data products and applications. QUALCOMM's code division multiple access ("CDMA") technology has been licensed to over 95 leading communications manufacturers worldwide. And due to its unsurpassed voice quality, system capacity, privacy and flexibility, CDMA is the recognized global standard for next-generation, digital wireless communications products and services.

In response to the Commission's inquiries regarding current trends in, and migration paths to, advanced wireless systems, including 3G (also known as "IMT-2000"), QUALCOMM's comments will focus on providing the Commission with data on: 1) the capabilities of the CDMA-based 3G technologies and their ability to meet projected market demands for voice and data services; 2) the ability of existing licensees to evolve their networks to 3G technologies and

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[1] Amendment of Part 2 of the Commission's Rules to Allocate Spectrum Below 3 GHz for Mobile and Fixed Services to Support the Introduction of New Advanced Wireless Services, Including Third Generation Wireless Systems, *Notice of Proposed Rulemaking*, ET Docket No. 00-258, RM-9920, RM-9911 (December 29, 2000) ("NPRM") (para.13).

[2] NPRM (para.13).

provide advanced services within current spectrum allocations; 3) the timeframe in which 3G technologies will be deployed; and 4) the steps that the Commission can take to facilitate regional and global roaming. Finally, QUALCOMM will provide comments on some of the spectrum pairing arrangements proposed by the Commission.

A. 3G Technologies – Meeting the Demand for Voice and Data Services

In its NPRM, the Commission noted that while only about two percent of mobile traffic is currently data, it is expected that data services will grow significantly in the near future.[4] For years, it was stated that the large rush for mobile data services was imminent. Limitations in technology, such as inadequate network capacity and a lack of enabling user devices and limited applications, have been blamed for the slow growth of data services. However, as new data-capable devices have become smaller, more economical, and diverse in their form factors, the limitations to wireless data service growth are quickly disappearing. In addition, people using the Internet for data services over wired lines are becoming more comfortable and familiar with data usage, while faster data speeds, capacity increases, and a family of new browser phones are opening the doors to allow wireless data to become an additional revenue stream for operators.

As voice services become a commodity in today's wireless industry, operators are facing a need to differentiate their services in order to attract new subscribers and to reduce churn. There are two predominate approaches to differentiating services: 1) offering packages with increased minutes of voice service; and 2) offering packages which include high-speed data services. These two approaches are fueling the demand for increased minutes of use, the need for additional

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[3] NPRM (para. 32).

[4] NPRM (para. 15).

network capacity, and the need for data speeds comparable to those achievable over wireline networks.

In response to these market drivers, the wireless industry, in conjunction with the ITU, developed a set of radio interface standards to meet demands for increased minutes of use as well as high-speed data capability. The family of standards known as IMT-2000 includes five separate radio interfaces, all of which meet the minimum performance criteria set by the ITU, including providing data speeds of 144 kbps for mobile traffic, 384 kbps for pedestrian traffic and 2 Mbps for fixed traffic. Several of these standards are based on CDMA technology, the technology QUALCOMM pioneered and continues to develop. It is anticipated that the majority of operators worldwide will adopt two of these standards - cdma2000 and W-CDMA. Both are based on the same underlying technology and meet the ITU's performance requirements for IMT-2000. Given that cdma2000 was designed as an evolutionary path for current cdmaOne operators to transition to 3G in operators' existing spectrum assignments, and is also an efficient solution for new spectrum allocations, QUALCOMM will respond to the issues raised in the Commission's NPRM in the context of the capabilities of cdma2000.

First, cdma2000 not only meets, but far exceeds, the data service performance requirements identified by the ITU for 3G. Cdma2000 is comprised of multiple modes: 1x, 3x and 1xEV (also known as High Data Rate ("HDR")). Using only a single 1.25 MHz carrier, the cdma2000 1x mode provides up to 307 kbps in a mobile environment, which is twice as fast as the ITU requires. The cdma2000 1x mode offers both voice and data capability over the same channel. The cdma2000 1xEV mode, on the other hand, uses a separate channel specifically

optimized for packet data services, with a flexible architecture based on IP protocols. This cdma2000 1xEV mode provides up to 2.4 Mbps in a standard bandwidth 1.25 MHz channel in a fixed, portable or mobile environment. This data-only solution *far* surpasses the data service capability foreseen for 3G by the ITU. These two modes, cdma2000 1x and 1xEV, can be deployed simultaneously using a single handset or user device as well as sharing the same network plans, towers and antennae, RF components, back office equipment, and IP backbone.

Second, cdma2000 provides additional benefits for operators, such as significantly increased network capacity for voice services. Of the second-generation systems in operation today, cdmaOne continues to be the most spectrally efficient technology, enabling operators to handle more simultaneous calls per unit of spectrum. The third generation evolution of cdmaOne, cdma2000, is nearly twice as efficient as its predecessor. This substantial increase in voice capacity will benefit both existing operators that may be facing network capacity constraints due to increased call volumes in their current spectrum assignments, as well as operators that will not have to acquire as much new spectrum to handle similar volumes.

In sum, the current trend in wireless technology is toward higher capacity, more efficient networks that can handle both voice and high-speed packet-based data services. After years of anticipation, wireless technology has finally matured to enable operators to meet the growing demand for basic voice services and to compete with traditional wireline systems, while also providing wireline-competitive data services to users in any environment. With its 1x and 1xEV modes, cdma2000 provides operators with options to meet the needs of varied market segments, whether they are customers demanding high minutes of use for voice and/or customer demanding

high-speed data services and Internet access.

B. Migration Paths to 3G – an Evolutionary Approach

In its NPRM, the Commission requests comments on the ability of existing first and second-generation operators to provide advanced services in currently licensed spectrum.[5] There are a number of factors, including regulatory policy, technology selection, quantity of available spectrum, efficient use of available spectrum, number of customers, type of service offered, and operating environment that all contribute to an operator's ability to use currently licensed spectrum for advanced services. QUALCOMM's comments will focus on regulatory policy, spectrum usage, and technology selection in particular.

First and foremost, it is the Commission's own flexible spectrum management policy of allowing existing operators to deploy new technologies in their markets without changing the license conditions or requiring a new license that has the greatest impact on an operator's ability to provide advanced services. This commendable policy has been the catalyst for much of the technological innovation that has occurred in the wireless industry over the past twenty years. U.S. cellular operators, licensed since the early 1980s, began operations using analog technology. Under the Commission's flexible spectrum allocation policy, which allows operators to make efficient use of their assigned frequencies and deploy new technologies in response to market forces, the U.S. cellular operators have all converted some or most of their analog cellular equipment to digital, improving the quality of service to their customers, while making more efficient use of the available spectrum.

[5] NPRM (para. 22).

In addition to a favorable regulatory environment that encourages innovation, efficient spectrum use as well as evolution and enhancement of existing systems, there are other factors that play an important role in an operator's ability to use their existing frequencies to offer advanced services. One of the most important factors is an operator's selection of technology and its spectral efficiency. While all digital technologies in use today are more efficient than the analog systems initially deployed by the U.S. cellular operators, digital technologies are not equal in terms of their spectral efficiency, meaning their ability to process high volumes of users and minutes of use. CDMA is the most spectrally efficient technology available, and it enables operators to handle, in limited and encumbered spectrum, significant numbers of simultaneous users and large quantities of minutes of use. In order to maintain high quality service for voice customers, accommodate increased call volumes and duration, and also provide new advanced services such as high-speed data, U.S. cellular and PCS operators will have to maximize the use of their existing frequency assignments by using the most efficient technologies available.

A critical factor in an operator's ability to use existing frequency assignments to provide advanced services such as 3G is the cost and ease of upgrading existing equipment. Traditionally, the largest expenditure an operator faces is network equipment and implementation. The high cost of acquiring new licenses puts additional pressures on operators to develop sound business plans, which makes equipment investment even more important. Upgrading that equipment to provide new advanced services must be done in a smooth, seamless manner. Therefore, in order to take advantage of the latest technological breakthroughs, while maintaining a high quality of service to its existing customer base, which may choose not to subscribe to new advanced

services, an operator must have flexibility in upgrading its system to meet market demands.

The flexible evolution of cdmaOne and cdma2000 offers operators a choice in system upgrades. Whether individual markets demand advanced feature sets for voice and data needs, such as high-speed Internet access, or simply require increased capacity for voice minutes of use, the CDMA evolution provides a stepped, or phased approach with minimal investment upgrades. For existing cdmaOne operators, the required network upgrade investment to cdma2000 1x consists primarily of software changes and channel card upgrades. Operators can leverage their investments in all other existing network equipment, such as cell sites, towers and antennas. Cdma2000 handsets are backward compatible with cdmaOne networks and cdmaOne handsets are forward compatible with cdma2000 networks. This means that both cdmaOne and cdma2000 handsets operate on either a cdmaOne or cdma2000 network. This backward and forward compatibility significantly reduces the difficulties and costs associated with rolling out new equipment across various markets.

From an equipment production standpoint, there are also substantial benefits to an evolutionary upgrade approach. In order to produce cdma2000 handsets, a manufacturer will require a new chipset. The cdma2000 1x chipsets that QUALCOMM provides are pin-compatible with QUALCOMM's cdmaOne chipsets, so that handset manufacturers using the cdmaOne chips can introduce cdma2000 1x handsets rapidly by reusing existing handset designs and software applications. In this way, evolutionary equipment design eases the transition to new technologies for operators, manufacturers and consumers alike.

In conclusion, there are several factors that contribute to an operator's ability to deploy

3G technologies and provide advanced services in their existing frequency assignments. The Commission's flexible spectrum policy is the most important contributing factor in that it promotes efficient use of spectrum, technological innovation, and market driven technology decisions. In the next section, QUALCOMM will demonstrate that it is this policy that is enabling U.S. operators to offer advanced wireless services using 3G technologies much sooner than operators in countries where regulatory restrictions require operators to acquire new spectrum to take advantage of technological advancements and offer new services.

C. Timeframe for 3G Technology Deployments

In its original plan for IMT-2000, the ITU envisioned that operators would deploy the 3G technologies in the 2000 timeframe. Right on schedule, SK Telecom launched the world's first commercial 3G services in Seoul and Pusan, South Korea, in October of 2000. KDDI of Japan, and Sprint PCS, Verizon Wireless and Leap Wireless of the United States have announced they would likewise begin commercial service of cdma2000 in 2001. In these and other cases, the cdmaOne operators will upgrade their systems to cdma2000 using existing frequency bands, demonstrating that the evolutionary approach has significant time-to-market advantages.

By leveraging the investments in their second-generation systems, the CDMA operators will be able to offer their customer base increased minutes of use for voice and a host of high-speed data applications much sooner than operators that use other technologies. Unlike the cdmaOne and cdma2000 evolutionary upgrade path, none of the other first and second generation technologies have a clear migration path to 3G. The air interface used by other technologies is

fundamentally different from the CDMA air interface. This means that a non-CDMA operator seeking to upgrade its system to either cdma2000 or W-CDMA will have to replace all of its RF equipment to offer advanced services using 3G technology – a much more costly and disruptive undertaking than adding channel cards and a new software load to a cdmaOne system.

For those operators in countries where regulations require that they acquire new frequency assignments to deploy 3G technologies, the wait to offer new advanced services could be even longer. For example, European regulations mandate the use of GSM technology in the 900 and 1800 MHz bands. Operators with frequency assignments in these bands do not have the flexibility to deploy non-GSM technologies, such as cdma2000 or W-CDMA, unless they are given an amendment to their existing license by their national regulatory authority. Therefore, in order to provide their customers with increased minutes of use and high-speed data services, the existing cellular and PCS operators must acquire new licenses and new spectrum, often at significant costs, which will ultimately be borne by their customer base.

Not only does this restrictive regulatory approach lead to an inefficient use of spectrum by maintaining outdated networks at both 900 and 1800 MHz, but it also delays the introduction of 3G technologies and advanced services to European consumers. New 3G licensees must build entirely new networks from the ground up – a timely and costly exercise. Consumers in these countries will not see nationwide 3G networks until sometime in 2003 at the very earliest, which is at least two years later than consumers in Japan, Korea and the United States.

By allowing current operators to deploy 3G technologies in their existing bands, the Commission is facilitating the early introduction of advanced wireless services across the United

States. The Commission's policy is also helping to lower the potential costs of these new services to U.S. consumers.

D. Regional and Global Roaming Opportunities and Difficulties

While the Commission's flexible spectrum allocation policy has resulted in myriad benefits to the U.S. wireless industry and consumers, including efficient use of spectrum, technological innovation and early deployment of advanced services, some of its spectrum allocation decisions have been less advantageous. For example, although many countries in the Americas and some parts of Asia use the 800 and 1900 MHz bands in the same manner that the United States does, the U.S. cellular and PCS bands are not used on a harmonized basis at a global level.

QUALCOMM concurs with the Commission's statement that "global roaming would be facilitated by having a single global band for 3G systems," and that this is an unlikely outcome for the foreseeable future.[6] Therefore, regional and global roaming will only be possible through the use of multi-band handsets. Given that it is equally unlikely that all operators will use the same technology for the foreseeable future, it is also safe to say that regional and global roaming will also be dependent on the existence of multi-mode handsets. The development of multi-band, multi-mode equipment has been an expensive and lengthy process, which requires dedicated engineering resources. QUALCOMM believes that this situation is improving significantly with the introduction of new technologies that drive down cost and reduce complexity in multi-band, multi-mode handsets.

However, it is true that by reducing the number of possible frequency bands used around

[6] NPRM (footnote 47).

the world, and harmonizing that use to the greatest extent possible, wireless equipment manufacturers will be able to focus their efforts on developing equipment with fewer variations, speeding up time-to-market for the equipment as well as reducing equipment costs. The U.S. wireless market is one of the largest in the world with over 110 million subscribers.[7] While this is a sizeable market, it is but a fraction of the one billion global subscribers that are expected by 2002.[8] QUALCOMM recognizes that only a small percentage of these subscribers will ultimately have the need for global roaming capabilities. There are nevertheless significant advantages to be gained from creating global economies of scale for wireless equipment.

Therefore, as the Commission considers making additional spectrum available for wireless services, it should take into consideration the use of those frequencies by countries around the world and attempt to harmonize that use to the greatest extent possible with other countries. U.S. consumers and industry will ultimately benefit from the opportunities created by spectrum harmonization, both in terms of international roaming and lower equipment costs.

[7] The World of Wireless Communication, Statistics and Surveys, CTIA's Semi-Annual Wireless Industry Survey available at http://www.wow.com/wirelesssurvey/1299datasurvey.pdf.

[8] *A Billion Callers by 2002*, Wireless Week, March 13, 2000.

E. Frequency Pairing Arrangements

In its NPRM, the Commission indicates that it will continue to apply its flexible spectrum policy to several frequency bands, including the currently allocated cellular, SMR and PCS bands 806-960 MHz and 1850-1910/1930-1990 MHz.[9] The Commission also proposes to extend this policy to the 746-806 MHz band, which will be auctioned for commercial use later in 2001. QUALCOMM commends the Commission's decision regarding use of these bands and notes that operators in these bands are offering the world's first advanced services using 3G technologies.

With regard to the other bands identified by the Commission as candidate bands for future provision advanced wireless services, QUALCOMM will focus its discussion on the 1710-1850 MHz and 2110-2165 MHz bands. QUALCOMM agrees with the Commission that the two bands, which were identified for reallocation to non-government use by statutory directive, namely 1710-1755 MHz and 2110-2150/2160-2165 MHz, are good candidate bands for deploying 3G technologies. However it is not clear that the pairing of these two bands together is the best use of these frequencies from a global harmonization perspective. A better pairing arrangement of frequencies in the 1700 MHz range would be to follow the DCS-1800 allocation scheme used by the majority of countries around the world for second-generation services, including countries throughout the Americas.

The United States could not follow exactly the DCS-1800 allocation scheme, which pairs 1710-1785 MHz with 1805-1880 MHz, without re-farming the U.S. PCS frequencies, which is an unattractive option from the perspective of the PCS operators and the significant investments made in those networks. However, the United States could use a portion of the 1700/1800 MHz

[9] NPRM (para. 34).

frequencies and pair them in a manner that maintains the DCS-1800 duplex spacing of 95 MHz, which would facilitate the use of equipment already produced for those frequencies. Were the United States to allocate frequencies in this range in a harmonized manner with the majority of other countries in the world, this band could eventually become the single, globally harmonized band, which would facilitate global roaming and increased economies of scale.

Moreover, were U.S. operators to deploy 3G technologies in these bands, there could be significant pressure created to encourage administrations that have imposed restrictive regulations on operators using these bands to permit those operators to deploy new 3G technologies and offer advanced wireless services in those frequencies. The technical work required to combine GSM and CDMA in a single handset for the purpose of inter-standard roaming is already in process, since new 3G licensees in Europe realize they must provide such multi-mode, multi-band handsets to offer roaming for their 3G customers during the lengthy period required to deploy new nationwide networks.

If it is not feasible to clear or share with the incumbent users of the 1755-1850 MHz band and allocate these frequencies in a manner that is consistent with the DCS-1800 band plan, QUALCOMM considers the next best option for achieving some harmonization to be the pairing of 1710-1755 MHz with 2110-2150/2160-2165 MHz. Many countries around the world are planning to deploy 3G technologies using 1920-1980 MHz paired with 2110-2170 MHz. While the United States could not follow this allocation scheme without re-farming the PCS bands, it could, at a minimum, achieve some harmonization by using the 2110-2150 and 2160-2165 MHz frequencies in a manner that is consistent with what numerous other countries are doing in the

band. For example, by using the 2110 MHz frequency range as a global common downlink band, there may be advantages in terms of equipment development to offer roaming capability and achieve some economies of scale. In addition, this option is palatable to several countries in the Americas, which would provide regional roaming opportunities and some additional economies of scale.

The downside to this pairing option is that the frequencies above 2 GHz are unlikely to support roaming services outside of metropolitan areas for quite some time, especially in Asia and the developing world. The DCS-1800 band, which is already developed for GSM services in most of the world, would offer a more reliable set of frequencies on which U.S. consumers could roam for voice services utilizing multi-mode handsets.

F. Conclusion

QUALCOMM applauds the Commission for its leadership and sound spectrum management policies that permit licensees freedom in determining the services to be offered and the technologies to be used, while also encouraging the most efficient use of assigned frequencies in response to market demands. QUALCOMM notes that the United States will be among the first countries in the world to enjoy the benefits of new 3G technologies and the advanced services they will provide as a direct result of the Commission's flexible spectrum policy. Finally, QUALCOMM encourages the Commission to allocate any additional spectrum available in a manner that will maximize opportunities for global roaming and economies of scale.

Respectfully submitted,

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February 22, 2001